Diffusion Sampling Method Saves Time and Cost

NSA MID-SOUTH

A new groundwater sampling method for VOCs is yielding better quality analytical data at a lower cost for Naval Support Activity (NSA) Mid-South in Millington, Tennessee.

Site/Location:	Runway Apron Area, at the Naval Support Activity Mid-South, Millington, TN
Site Description:	Random small-quantity solvent disposal; chlorinated solvent plume in groundwater.
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Technology:	Diffusion sampling for volatile organic compounds in groundwater
Contaminant:	Trichloroethylene (TCE), Tetrachloroethylene (PCE), Dichloroethylene (1,1-DCE), 1,2-Dichloroethylene (1,2-DCE), 1,1-Dichloroethane (1,1-DCA), 1,2-Dichloroethane (1,2-DCA), Chloroform, and Carbon Tetrachloride
Action Levels:	MCL's. Prevent further contaminant migration and aquifer degradation.
Legal Driver:	Resource Conservation and Recovery Act (RCRA)
Decision Document:	N/A

Project Summary

When data from the new groundwater sampling technique — contaminant diffusion — were compared to historically collected standard pumping method data, the new method produced similar, if not more representative results.

The U.S. Environmental Protection Agency (EPA) brought this method, developed by the U.S. Geological Survey and General Electric Gas Turbine, to the BRAC Cleanup Team's (BCT) attention in August 1998. The Navy performed a pilot-scale test using this technology to determine its accuracy and applicability.

In September 1998, diffusion samplers were installed in three wells at NSA Mid-South where chlorinated solvents had been detected historically using conventional sampling methods (i.e., three well-volume purge and low-flow techniques). The Navy found that the analytical data from the diffusion sampling method correlated well, provided representative sampling at discrete depths, and was less expensive than traditional sampling.

Regulatory Requirements/Community Involvement

The diffusion sampling method was brought to the BCT's attention by the EPA. Quality project execution was met through effective partnering with regulatory agencies, and community participation was provided via Restoration Advisory Board (RAB) meetings.

Construction Challenges

The diffusion sampler — a weighted, polyethylene bag containing deionized/ organic-free water, is placed in a well at a selected depth and left long enough to allow equilibrium to be achieved between concentrations of volatile contaminants in the groundwater flowing through the well screen and the water in the sampler. Equilibrium occurs in as little as 48 hours, but the sampler may be left in place longer, if desired.

Because contaminant concentrations may differ along the screened interval, diffusion samplers of discrete lengths (e.g., 1 or 2 feet) may be "stacked" from the bottom of the screen to the top to provide a vertical profile of concentrations.

When the diffusion sampler is retrieved, the sample is collected by filling the appropriate sample container. Stainless-steel weights that position the diffusion sampler may either be dedicated to the well or decontaminated for use at another location. In addition, a new diffusion apparatus may be installed as the old one is being removed.

Cost Avoidance Measures

Even though low-flow sampling techniques decreased the cost of groundwater sampling compared to the conventional three-volume purging technique, considerable costs were still incurred through the rental or purchase of pumps,

portable electric generators, and water-quality monitoring instruments. In addition, the labor costs incurred from extended time in the field were significant.

Diffusion sampling virtually eliminates many of these costs and greatly diminishes others. For example, the equipment cost, using standard low-flow purging to sample 20 wells averaging 80 feet deep, excluding labor and investigation derived waste (IDW) costs, would be approximately $118 per well using the standard sampling methods, (rental of electric generator, pump, water-quality instruments, purchase of sample tubing to be dedicated to each well, etc.), and approximately $34 per well in follow-up sampling (including only the rental costs).

Conversely, equipment cost for sampling the same 20 wells using the diffusion method would cost approximately $7 per well the first time (purchase of a roll of polyethylene sampler sleeving, protective sleeving, nylon twine, and stainless-steel weights to be dedicated to each well) and approximately $1 per well thereafter (purchase of protective sleeving and twine).

Labor costs and time in the field also decrease greatly when the diffusion method is employed because the samplers can be installed and sampled in approximately 30 minutes per well. Standard sampling methods using pumps can take anywhere from 60 to 90 minutes per well to set up the equipment and conduct the sampling. For example, 65 diffusion samplers were installed/ retrieved in monitoring wells by 4 people in 2 days. To collect the same amount of samples using a pumping method would take a minimum of 2 weeks.

Standard pumping methods also require equipment to be decontaminated after each well is sampled, consequently increasing the chances for cross-contamination. Using the diffusion method, only the stainless-steel weights that hold the bag in place need to be decontaminated, and this is only if the weights are no longer dedicated to the well.

Project Successes

In summary, the primary advantages of the new technique are:

- A more representative sample is collected because the groundwater is disturbed the least.
- Lower labor and equipment costs due to shortened field time and little or no standard sampling method related equipment purchases/rentals.
- Less IDW since well purging prior to sample collection is unnecessary.
- Hard-to-reach wells become more accessible because very little equipment needs to be taken to a well in order to conduct sampling.
- The potential for cross-contamination is virtually eliminated because no decontamination procedures are necessary between wells.
- Improved quality of the resulting analytical data. In some cases, the diffusion method allowed for the detection of compounds that either had not previously or consistently been detected using pumping methods.
- Vertical profiling of contaminants by using short length diffusion samplers "stacked" within the screened interval of a well.

Lessons Learned

The pilot-scale test results indicate that concentrations may vary with discrete depths in a given well screen. In addition, diffusion sampling data compares favorably with low-flow sampling at similar depths. Therefore, diffusion sampling is an efficient viable alternative to conventional groundwater sampling techniques.

Figure 1: ***Attachment to well cap.***

Figure 2: ***Diffusion sampler.***

Figure 3*: Retrieving a sample.*

Figure 4*: Stainless steel weights.*